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Summary

Many of today's popular sports are based around the use of balls, yet none of the balls are completely alike. In fact, they are all designed with specific characteristics in mind and are quite varied. Students investigate different balls' abilities to bounce and represent the data they collect graphically.

Engineering Connection

Relating science concept to engineering

Materials scientists and engineers identify the properties of many different materials and recommend their best uses. This activity demonstrates reverse engineering, in which the properties of finished products are determined by performing tests on the products.

Contents

Grade Level: 4 (3-5)

Group Size: 3

Time Required: 100 minutes
2 or 3 class periods.

Activity Dependency :None

Expendable Cost Per Group : Not defined

Keywords: athletics, data, experiment, graph interpretation, graphing, materials science, reverse engineering, sports, teamwork

Related Curriculum :

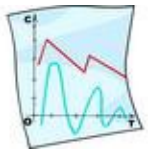
subject areas Measurement
Physical Science

Educational Standards

- International Technology and Engineering Educators Association: Technology
- D. Tools, materials, and skills are used to make things and carry out tasks. (Grades 3 - 5) [2000]
- J. Materials have many different properties. (Grades 3 - 5) [2000]
- L. Requirements are the limits to designing or making a product or system. (Grades 3 - 5) [2000]

- D. Requirements for a design include such factors as the desired elements and features of a product or system or the limits that are placed on the design. (Grades 3 - 5) [2000]
- C. Compare, contrast, and classify collected information in order to identify patterns. (Grades 3 - 5) [2000]
- E. Examine the trade-offs of using a product or system and decide when it could be used. (Grades 3 - 5) [2000]
- Massachusetts: Math
- Construct, draw conclusions, and make predictions from various representations of data sets, including tables, bar graphs, pictographs, line graphs, line plots, and tallies. (Grades 3 - 4) [2000]
- Match representations of a data set such as lists, tables, or graphs (including circle graphs) with the actual set of data. (Grades 3 - 4) [2000]
- Use pictures, models, tables, charts, graphs, words, number sentences, and mathematical notations to interpret mathematical relationships. (Grades 3 - 4) [2000]
- Represent real situations and mathematical relationships with concrete models, tables, graphs, and rules in words and with symbols, e.g., input-output tables. (Grades 5 - 6) [2000]
- Collect and organize data using observations, measurements, surveys, or experiments, and identify appropriate ways to display the data. (Grades 3 - 4) [2000]
- Produce and interpret graphs that represent the relationship between two variables in everyday situations. (Grades 5 - 6) [2000]
- Massachusetts: Science
- 2.1 Identify a problem that reflects the need for shelter, storage, or convenience. (Grades 3 - 5) [2001]
- 1.1 Identify materials used to accomplish a design task based on a specific property, i.e., weight, strength, hardness, and flexibility. (Grades 3 - 5) [2001]

Learning Objectives (Return to Contents)



- How to run an experiment
- How to collect data.
- How to present data.
- How to interpret graphs.
- How to graph results.
- Teamwork

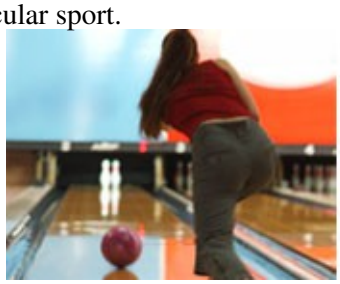
Materials List

- 4 different balls to test, such as a super ball, tennis ball, basketball, kickball, baseball, etc.
- 1 stopwatch per group
- 1 yardstick per group
- worksheets (see attachments)

Introduction/Motivation (Return to Contents)

Could you play tennis with a baseball or soccer with a basketball? (Listen to student responses.) What are all the different sports that are played with balls? (Possible answers: Volleyball, soccer, football, softball, baseball, ping pong, wiffle ball, bowling, dodge ball, golf, jacks, tennis, croquet, raquetball, squash, tetherball, etc.) What are some differences and similarities among the balls used for different sports?

How do the materials and design of a ball affect its characteristics? A soccer ball is designed to be bouncy, flexible and full of air, making it great to be kicked down a soccer field without injuring players. A bowling ball is dense, heavy and hard so that it can be rolled down a bowling alley to hopefully get a strike rather than a gutter ball. Each ball is designed with specific materials, making it appropriate for a particular sport.



When engineers are given a design task, whether it is designing a new volleyball that can bounce twice as high or a new airplane or skyscraper, they must study and analyze the properties of the materials they would like to use. What might be some material properties that they consider ? (Possible answers: Weight, strength, hardness and flexibility.)

Do you think it is important to understand materials and their properties, especially in the design of a ball used in a game? Well, imagine being the goalie in a soccer game that uses a bowling ball instead of a soccer ball. OUCH!!!

Procedure

Background Information

This activity coincides well with math graphing practice.

Recommended Resources:

Description of different graph types (line, scatter, bar, pie). Nice example pictures.
http://wwwslap.cern.ch/doc/NExS/html/node260.html

This is a link to an online game that teaches mean, median, and mode.
http://www.kidsmathgamesonline.com/numbers/meanmedianmode.html

Allows children to create graphs and experiments with probability. http://nces.ed.gov/nceskids/Graphing/

Instructions

1. Gather materials and make copies of the worksheets.
2. Explain the two tests that will be done to determine the bouncing properties of different balls.
3. Divide the class into groups of three students each. One student serves as the recorder, one drops the ball, and one is the timekeeper.
4. Assign each group a ball. After running both tests on that ball, have the groups switch balls (rotate) and test a new ball until all balls have been tested by each group.
5. Conduct tests and record data.

Test 1: Ball Bounce Height Comparison

The first time you drop the ball do not take a measurement, just watch where the ball goes so the next time the observer knows where to look. This help to greatly increase the accuracy of the experiment. Drop a ball from 1 foot off of the floor, slightly in front of a yardstick. Measure the height the ball reaches after the first bounce and record. Repeat this test from 2 ft, 3 ft, and 1/2 ft. Do this test for each ball and record data. You may have to try more than once to accurately judge the height of the first bounce.

Test 2: Ball Bounce Time Comparison

Drop a ball from a height of 3 ft, timing from when the ball is released until the ball stops bouncing. Record the time. Repeat this test for each ball. Talk with the students about coming up with a system for releasing the ball and starting the stop watch. Possible suggestions are to have the same student drop the

ball and start the watch, or have the two students count down from five.

6. Graph group results. (If this activity is not able to be accompanied by a math lesson on graphing, introduce the topic before the activity starts or perhaps after the class has recorded its data and worked through it as a group.)
7. Compare results as a class.

Attachments (Return to Contents)

- Ball Characteristics Worksheet (doc)
- Ball Characteristics Worksheet (pdf)
- Ball Bounce Experiment 1 Worksheet (doc)
- Ball Bounce Experiment 1 Worksheet (pdf)
- Ball Bounce Experiment 1 Bar Graph (doc)
- Ball Bounce Experiment 1 Bar Graph (pdf)
- Ball Bounce Experiment 2 Bar Graph (doc)
- Ball Bounce Experiment 2 Bar Graph (pdf)
- Test Worksheet (doc)
- Test Worksheet (pdf)

Investigating Questions (Return to Contents)

- Could you play basketball with a superball?
- Do smaller balls bounce higher?
- Do heavier balls bounce higher?
- Why are your results different from other groups' results?
- Why do some balls bounce higher than others?
- What other tests can you perform with the balls?
- Why is the design of a ball important?

Assessment (Return to Contents)

- Rubric for Performance Assessment (doc)
- Rubric for Performance Assessment (pdf)

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Supporting Program (Return to Contents)

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